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Original Article

Trends in short and long sleep in Denmark from 1964 to 2009, and the associations with employment, SES (socioeconomic status) and BMI

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ABSTRACT

Objective: The aim of the present study was to investigate changes in the prevalence of short and long sleepers in Denmark, and to explore the associations between socioeconomic status, body mass index and sleep duration.
Background: Sleeping behavior is considered to be a risk factor for morbidity and mortality, but there is little information on population sleep in Denmark; however, it is suspected that sleep durations have declined over time.
Data and methods: Data were used from five Danish population-representative time-use studies spanning 1964–2008/09.
Results: The proportion of short sleepers increased significantly until the end of the 1980s, whereafter it decreased significantly. The proportion of long sleepers reached a maximum in 1975. It was also found that the increase in women's employment rates was associated with half the decrease in their sleep duration over the last 45 years. In accordance with previous literature, it can be shown that both short and long sleep are associated with being overweight/obesity.
Conclusions: In Denmark, the same number of hours is slept today as in the mid-1960s, with nearly the same prevalence of short and long sleepers.

1. Introduction

Extreme sleep durations are seemingly independent risk factors for poor health. Epidemiological studies have found that both short and long sleep durations predict all-cause mortality [1]. Short sleep durations of less than 6 h have been linked to cardiometabolic risk [2], in particular, becoming overweight and obese [3], and have been subject to considerable study because it is believed that people nowadays sleep less than before [4]. Nevertheless, systematic review and analysis of data from 10 industrialized countries have found no consistent decrease in the average sleep duration of adults since the 1960s [4,5]. It appears that increases in the number of short sleepers have been relatively limited and that long sleep is more prevalent today [5]. This is contrary to expectations based on the idea of a trend toward more-productive and work-oriented societies, with more pronounced sleep deficits for the majority of the population [6]. However, little information exists on population sleep patterns in Denmark; accordingly, analyses of trends in sleep duration are lacking, an exception being the analyses of duration of sleep between 2007 and 2010 in the Copenhagen area [7].

Danish time-use studies over the last 45 years have made it possible to investigate the prevalence of short and long sleepers, and to show how socioeconomic factors and body mass index (BMI) may correlate with these sleeping behaviors. The aim of the present study was to investigate the prevalence of male and female short and long sleepers in Denmark, and to determine whether the prevalence has changed over time. Further aims were to investigate seasonal variation in sleep duration and to explore how employment, socioeconomic factors and BMI are related to sleep duration in this population.

2. Data and measures

The data came from five Danish time-use studies for the 45-year period 1964–2009. Surveys were conducted in 1964, 1975, 1987, 2001, and 2008/2009 (the most recent being in Denmark) using nationwide samples (Table 1). Time-use diaries came from representative samples of adults aged 18–74 years, drawn from administrative registers at Statistics Denmark.

The groups analyzed were aged 18–64 years; to ensure the highest possible response rates, older individuals were omitted from the present analyses. The numbers of observations included in the analyses are shown in Table 1, together with information on the different time-use studies used.

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Table 1
Sample description.

Survey year	Survey structure	Interview form	Randomly chosen days	Number		Response rates
				Spring (% female)	Full sample	
1964	Nationwide probability sample	Visit interviews	One weekday or weekend day	2661 (56.3)	2661	66.6
1975	Nationwide cluster sample	Visit interviews	One weekday or weekend day	2830 (47.6)	2830	72.7
1987	Nationwide probability sample	Visit interviews	One weekday and weekend day[3]	3049 (49.8)	3049	64.6
2001	Nationwide probability sample	Telephone	One weekday and weekend day[3]	845[1] (54.4)	2739	65.8
2008/09	Nationwide probability sample	Telephone and web	One weekday and weekend day[3]	809[2] (52.4)	5022	77.0

[1] Spring 2001.
[2] Spring 2009.
[3] Weighted together: 5/7 × weekday + 2/7 × weekend day.

All respondents kept 24-h diaries: in 1964 and 1975, one for a weekday or a weekend day; in 1987, 2001 and 2008/09, one for a weekday and one for a weekend day (ie, sampling only 1 day per respondent and the same time allocation appears). Sleep duration was calculated as the sum of all sequences of the day, with activity code 01 for all the years (unspecified sleep, sleep, and sick in bed) (see Eurostat's Guidelines 2000) [8]. For 1987, 2001, and 2008/09, the weekday and the weekend day information was weighted by 5/7 and 2/7 to find an average day's sleep. In 2008/09, the number of sleep sequences was two for 92.8% of the respondents on weekdays and 92.7% on weekend days (the diary period spans from 04:00 to 04:00 the following day). Only 7.2% and 7.3% had a higher number of sleep sequences, which lasted a relatively short time and took the form of naps.

Although the response rates were relatively high (see Table 1), the figures in every time-use study used here were weighted (age, sex, and income) by register information from Statistics Denmark to ensure that sleep duration and other factors represented that of the population.

2.1. Seasonality

To investigate changes in sleep duration and the proportion of short and long sleepers during 1964–2008/09, only data from spring (February–March) were used because the 1964, 1975, and 1987 Danish time-use studies covered only the spring period of the year. Information from the 2001 and 2008/09 studies was therefore selected by including only data collected during the spring (February–April 2001 and January–April 2008/09). This is why the number of respondents used from the 2001 and 2008/2009 surveys was relatively small, although the 2001 study also gathered information in the fall, and the 2009 study did so for a full year [9,10].

Table 2 shows that the spring period of 2008/09 is representative of the other seasons. The longer sleep duration in the winter counterbalances the shorter duration in the summer. The same holds for the prevalence of short and long sleepers, with the exception in the fourth quarter; here, the number of long sleepers was significantly higher than that of the first quarter.

2.2. Measures

According to Knutson [2], sleep duration using diary studies is reported to be approximately 1 h longer than when applying information from questionnaires asking, for example, about the amount of time usually spent in bed (see also [11]). Hence, calculations using not only the cut-off points of <6 h for short sleepers and 9+ h for long sleepers, which is in accordance with other studies of sleep durations [1], but also <7 h and 10+ h were looked at, giving very similar results (not shown).

It is well documented that sleep and being overweight are related [3], for which reason information about BMI was also included. This was defined in accordance with the usual practice of: normal weight spanning from 18.5 to 24.9 kg/m^2, overweight from 25.0 to 29.9 kg/m^2 and obesity as above 30.0 kg/m^2 in the statistical analyses. As there were few underweight individuals in the sample (60 people or 2.3%), these people were omitted from the calculations.

Although the height and weight of the respondents were self-assessed, based on written instructions (see Reference 12), the distributions calculated were very similar to those obtained when measurements by health professional were used; see Reference 13.

Education was included as a categorical covariate: with no post-school education; vocational education; and short, medium and long further education (ISCED coding). Age was included, with groupings of 18–29 years, 30–44 years, and 45–64 years. 'Children' referred to no children living at home, youngest child <7 years of age and youngest child 7–17 years of age. Civil status was 'single' or 'couple' (married or cohabiting). Employment was categorized as: no job/not in education, work hours <37, 37, 38–44 and 45+ and retired; 37 h refers to the standard full-time working week in 2008/09.

3. Statistical analyses

A linear regression model was used to analyze the changes in average sleep duration over time, where year was the sole predictor (Table 3). Moreover, the sleep duration variable was dichotomized into short sleep, and others and long sleep and others, with year (continuous variable) as the sole predictor to determine changes in

Table 2
Sleep duration and seasonality (18- to 64-year-olds, 2008/09).

	Mean sleep duration (hours) (95% CI)	Short sleep <6 hours Percentage (95% CI)	Long sleep 9+ hours	Number
2. Quarter 2008 (April–June)	7.93 (7.84–8.01)	7.10 (5.72–8.47)	19.29 (17.18–21.4)	1.494
3. Quarter 2008 (July–September)	7.89 (7.80–7.97)	8.64 (7.11–10.18)	19.43 (17.27–21.59)	1.416
4. Quarter 2008 (October–December)	8.24 (8.15–8.33)	6.35 (5.02–7.67)	26.24* (23.85–28.63)	1.300
1. Quarter 2009 (January–March)	8.07 (7.96–8.18)	6.89 (5.12–8.65)	20.18 (17.39–22.98)	809

* Significantly different relative to 1 quarter on a 0.05 level.

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Table 3
Trend in sleep duration 1964–2008/09 (18- to 64-year-olds).

	Mean sleep duration Minutes/day/year Coefficient (*t*-value)	Short sleep <6 hours %/year Coefficient (*t*-value)	Long sleep 9+ hours %/year Coefficient (*t*-value)
Linear regression (year-coefficient)[1]			
Men	–0.39 (–1.20)	–0.07 (–0.63)	–0.14 (–1.07)
Non/unemployed	**–1.34*** (–3.35)	–0.13 (–0.93)	–0.30 (–1.48)
Employed	–0.33 (–1.09)	–0.06 (–0.49)	–0.11 (–1.07)
Women	**–0.44*** (–2.18)	–0.08 (–1.16)	–0.16 (–1.53)
Non/unemployed	–0.07 (–0.22)	–0.05 (–0.64)	0.07 (0.45)
Employed	**–0.47*** (–2.40)	**–0.16*** (–2.82)	–0.16 (–1.80)
Average sleep (hh:mm) and prevalence[2]			
Men	07:50	12.7%	18.4%
Non/unemployed	08:09	11.3%	27.2%
Employed	07:44	13.1%	16.4%
Women	08:08	9.1%	23.8%
Non/unemployed	08:25	7.3%	32.0%
Employed	07:53	10.7%	19.0%

Note: Self-reported employment status from the surveys.
[1] The model includes a continuous year variable 1964–2009.
[2] Average and prevalence are calculated over the five years 1964, 1975, 1987, 2001 and 2009.
* Significant difference at 0.05 level.

the likelihood of short and long sleep over time for both estimations by applying probit-models (Table 3).

The analyses of the correlation between short or long sleep durations and BMI and socioeconomic and health factors (see descriptions in Table 4), were performed as multinomial regression estimations with three outcomes: short sleep, mid-range sleep, and long sleep, with all the covariates included in the models simultaneously (Table 5).

To investigate whether the developments in the prevalence of short and long sleep depend on the definition of these categories, a robustness analyses was conducted, with 7 h and 10 h as the limits.

For all the analyses, the statistical program STATA was used.

4. Results

4.1. Sleep duration and the prevalence of short and long sleepers

For men, it was found that sleep duration varied over the period of time, with a maximum average sleep of 489 min (8 h 9 min) in 1975 and a minimum of 458 (7 h 38 min) in 1987 and 2001, with the 1964 and 2009 figures found somewhere in between. The variation for women was smaller than that for men, with a maximum average sleep of 503 min (8 h 23 min) in 1975, 493 min (8 h 13 min) in 1964 and around 480 min (8 h) in the other years (Fig. 1 and Fig. 2). Thus, for men, compared with the average sleep duration in 1964, the average sleep duration increased significantly by 14 min a day until 1975, while it decreased by 30 min from 1975 to 1987. No significant changes were found for the periods 1987–2001 and 2001–2008/09. For women, the only significant change in sleep duration was found between 1975 and 1987, with a decrease of 22 min per day.

The prevalence of short-sleeper men increased significantly during 1975–1987 (11.9% to 18.9%), whereas a decrease in short sleepers was found for both men and women during 1987–2001 (18.9–9.3% and 12.5–5.8%, respectively) (see Fig. 1 and Fig. 2). For the remaining periods, no significant changes in the prevalence of short sleepers were found. From 1964 to 1975, the prevalence of long sleepers increased for both women and men, but from that time onward, it was found that fewer people in Denmark slept more than 9 h a night. Thus, the proportion peaked in 1975, with 26% of men and 31% of women being long sleepers that year. In the other years, around 18% and 20% of the two genders were long sleepers; the exception was 2001, when 11% of men were long sleepers.

Calculating a linear trend for the period 1964–2008/09 showed that for men, sleep duration did not change significantly; the slope of the trend was not significantly different from 0. For women, a 4.5 min/day decrease over a 10-year period was found (Table 3, column 1).

The prevalence of short and long sleepers remained the same during 1964–2008/09 for both men and for women, using the <6 and 9+ h cut-off points (Table 3, columns 2 and 3).

That the fluctuations in sleep duration from year to year, and the prevalence of short and long sleep follow economic changes, was not confirmed for Denmark, despite the unemployment rate varying considerably over the period. The unemployment rates for men/women were: 1.3/0.4, 5.8/3.9, 6.1/9.5, 4.5/6.2 and 5.3/3.8 in the years 1964, 1975, 1987, 2001 and 2009, respectively. These figures were calculated from the surveys, which were all weighted to represent the Danish population. Hence, the coefficients in a multiple regression including year and unemployment coefficients were not found to be significant for

Table 4
Descriptive statistics: sleep duration and number of cases by socio-economic factors (18- to 64-year-olds, 2008/09, $n = 5022$).

Covariate	All Average (95% CI)	Short sleep <6 hours Average (95% CI)	Long sleep 9+ hours Average (95% CI)
Sleep duration (hours/day)	8.02 (7.98–8.07)	5.06 (4.96–5.16)	10.12 (10.03–10.20)
Age (years)	43.6	41.7	40.6
	Numbers	% of All sleepers within the group	
Gender			
Male	2398	8.8	17.5
Female	2624	5.3	20.2
	Men/women	Men/women	Men/women
Employment			
No job	141/257	5.0/6.2	31.9/25.7
Work hours <37	364/502	10.2/4.4	14.6/22.1
Work hour = 37 (reference group[1])	766/757	8.9/6.6	15.7/18.1
Work hours 37–44	357/337	10.4/4.7	15.7/15.7
Work hours 45+	565/441	8.5/6.0	14.7/16.3
Retired	205/330	6.3/3.0	30.2/27.9
Education			
No education (reference group)	445/512	8.8/6.4	22.7/25.2
Vocational education	1065/853	9.6/4.1	16.0/17.9
Short tertiary education	142/290	8.5/5.2	21.1/23.1
Medium long tertiary education	362/694	7.5/5.5	17.1/18.7
Long tertiary education	384/274	7.8/6.9	14.6/19.0
Age			
18–29 (reference group)	293/292	9.6/4.5	25.6/33.2
30–44	809/969	9.9/6.4	15.1/16.1
45–64	1296/1363	7.9/4.8	17.1/20.2
Civil status			
Single (reference group)	406/388	10.1/6.2	24.9/25.0
Couple	1992/2236	8.5/5.2	16.0/19.4
Children			
No children (reference group)	1219/1284	8.2/4.9	21.1/24.3
Youngest child <7 years of age	406/446	11.3/6.1	12.1/13.5
Youngest child 7–17 years of age	773/894	8.2/5.6	14.5/17.8
BMI[1]			
normal weight (a) (reference group)	791/1.152	6.8/6.1	18.5/18.6
Overweight (b)	861/574	9.3/5.1	17.0/18.5
Obese (c)	737/835	10.3/4.7	17.0/23.4

[1] The standard full-time working week in 2008/09 in Denmark.

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Table 5
Associations between short and long sleep and socioeconomic factors (multi-nominal regressions, OR and CI; 18- to 64-year-old men and women; 2008/09).

	Men ($n = 2330$)		Women ($n = 2479$)	
	Short (<6 h) vs normal sleep (6–9 h)	Long (9+ h) vs normal sleep (6–9 h)	Short (<6 h) vs normal sleep (6–9 h)	Long (9+ h) vs normal sleep (6–9 h)
	Odds Ratios (95% CI)			
Employment				
No job	0.616	1.996***	0.890	0.992
	(0.311–1.220)	(1.388–2.869)	(0.501–1.581)	(0.698–1.410)
Work hours <37	1.312	0.898	0.724	1.429*
	(0.819–2.102)	(0.603–1.339)	(0.422–1.242)	(1.042–1.960)
Work hour = 37 (reference group[1])	–	–	–	–
Work hours 37–44	1.166	0.804	0.665	0.786
	(0.743–1.828)	(0.552–1.171)	(0.352–1.255)	0.523–1.180)
Work hours 45+	0.982	0.924	0.753	0.874
	(0.651–1.480)	(0.674–1.268)	(0.423–0.779)	(0.606–1.259)
Retired	0.754	2.107***	0.383**	1.934***
	(0.396–1.436)	(1.451–3.060)	(0.188–0.779)	(1.379–2.710)
Education				
No education (reference group)	–	–	–	–
Vocational education	1.371	0.829	0.453**	0.759+
	(0.910–2.067)	(0.629–1.093)	(0.277–0.743)	(0.574–1.004)
Short tertiary education	1.140	1.479	0.501*	1.378 +
	(0.536–2.424)	(0.925–2.367)	(0.253–0.992)	(0.964–1.970)
Medium long tertiary education	0.973	0.936	0.554*	1.059
	(0.545–1.737)	(0.642–1.364)	(0.327–0.938)	(0.778–1.441)
Long tertiary education	1.091	0.864	0.550+	1.019
	(0.627–1.900)	(0.585–1.275)	(0.279–1.081)	(0.667–1.554)
Age				
18–29 (reference group)	–	–	–	–
30–44	1.217	1.161	2.299*	0.530***
	(0.752–1.968)	(0.825–1.633)	(1.212–4.362)	(0.372–0.756)
45–64	1.021	0.929	1.461	0.454***
	(0.635–1.641)	(0.666–1.297)	(0.796–2.682)	(0.328–0.628)
Civil status				
Single (reference group)	–	–	–	–
Couple	0.734	0.899	0.737	1.157
	(0.507–1.064)	(0.696–1.161)	(0.498–1.091)	(0.921–1.454)
Children				
No children (reference group)	–	–	–	–
Youngest child <7 years of age	1.102	0.545**	0.813	0.506***
	(0.671–1.809)	(0.359–0.826)	(0.445–1.485)	(0.344–0.744)
Youngest child 7–17 years of age	0.785	0.654**	0.895	0.826
	(0.513–1.201)	(0.477–0.896)	(0.566–1.415)	(0.629–1.085)
BMI[2]				
Normal weight (a) (reference group)	–	–	–	–
Overweight (b)	1.397+	0.985	0.526*	0.872
	(0.948–2.059)	(0.757–1.283)	(0.316–0.876)	((0.658–1.156)
Obese (c)	1.661**	0.952	0.678+	1.338*
	(1.139–2.422)	(0.732–1.238)	(0.452–1.017)	(1.067–1.677)
Log-likelihood	−1714.227		−1669.076	
LR chi-squared (32)	125.17		139.97	
Pseudo R^2	0.0352		0.0402	

[1] The standard full-time working week in Denmark.
[2] (a) 18.5 < ,= BMI < 25; (b) 25 < ,= BMI < 30; (c) BMI >,= 30. Underweight persons are excluded.
–, Standard in regression analyses, as it is the comparison group.
+$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

women or for men (not shown here), which may be due to short unemployment spells for Danish employees. However, a steep increase in women's employment rate from 34% in 1964 to 68% in 2009 was associated with half the decrease in their average duration of sleep (–0.21 vs –0.44 min/day/year). No such impact was found for men (–0.46 vs –0.39 min/day/year), whose employment rate remained nearly constant (ie, 88% in 1964 and 84% in 2009).

4.2. Short and long sleep, and socioeconomic and health factors

Table 4 shows that the prevalence of short sleepers for men was higher than that for women [8.8% vs 5.3%], while the opposite appears for long sleep, with more women than men sleeping 9 h or more a day (17.5% vs 20.2%). Table 4 also shows the number and prevalence of short and long sleepers for men and women, characterized by: age, education, children, civil status, employment, and BMI. For the different categories used, the short sleep prevalence was between 3.0% and 11.3% (retired women and men with preschool children), and the long sleep prevalence was between 13.5% and 31.9% (women with preschool children and men not in work or education). This implies that the great majority in every group are mid-range sleepers.

Table 5 shows the results from the multinomial regression models, where the regression coefficients are presented as odds ratios to facilitate interpretation. A likelihood-ratio test shows that all the variables contribute to the model. It can be seen that education was not correlated with the prevalence of men as short or long sleepers, whereas for women, education per se decreased the likelihood of short sleep relative to having no education. Long sleep was also significantly less prevalent for women with vocational education,

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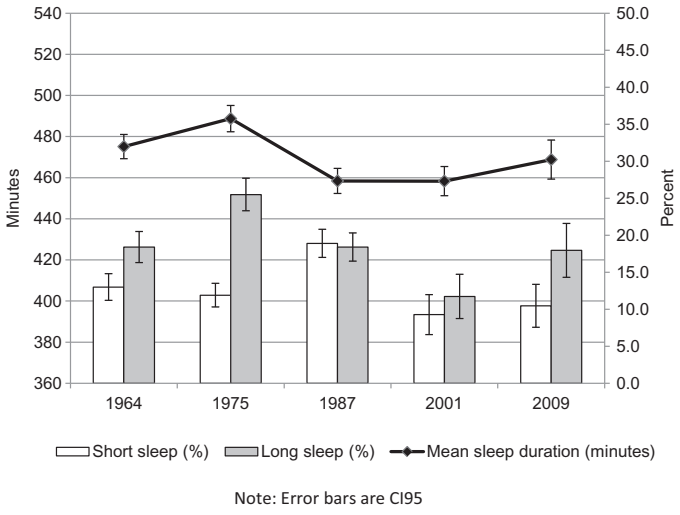

Fig. 1. Men's average sleep duration, proportion of short and long sleepers on an average day. 18- to 64-year-olds in 1964, 1975, 1987, 2001 and 2009.

but more prevalent for women with a short tertiary education than for women without education.

With increasing age, the prevalence of short sleep rose to a certain point (30–44 years) and then decreased for women (Table 5), while for men there was no such significant pattern. Conversely, long sleep was less prevalent for women over 29 years of age than for women below that age. For men, age had no impact on long sleep. Having preschool or school-aged children had no impact on women and men's likelihood of being short sleepers. However, having children decreased the likelihood of men being long sleepers, while for women, only preschool children decreased the likelihood of long sleep. Marriage or cohabitation did not correlate significantly with women or men's short or long sleep.

Labor market status and the prevalence of short and long sleep was also correlated, as relatively more men without work were more likely to be long sleepers than were men employed for 37 h (the standard full-time working week in Denmark in 2008/09). Further, more retired men and women were found to be long sleepers and fewer retired women were short sleepers than men and women with a 37-h working week, respectively. The number of hours worked

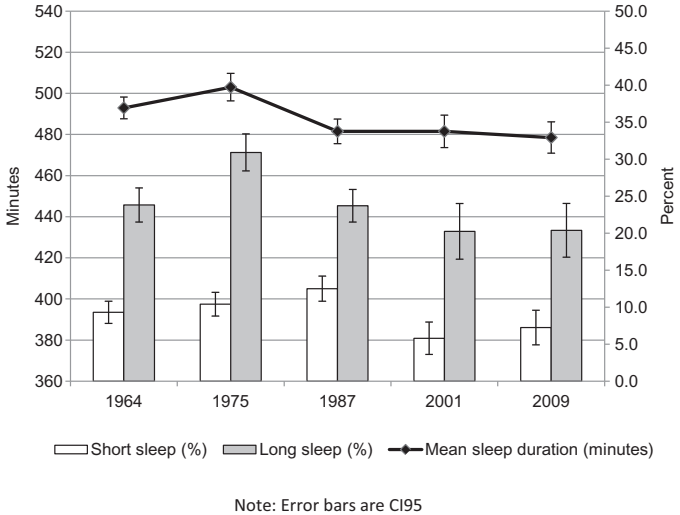

Fig. 2. Women's average sleep duration, proportion of short and long sleepers on an average day. 18- to 64-year-olds in 1964, 1975, 1987, 2001 and 2009.

was significantly correlated with women's but not men's sleep. Less than full-time work increased the number of long sleepers in women. This may indicate that longer working hours cause a decrease in sleep duration in women, or that women who are long sleepers choose to work part-time. For men, no such correlation was found between labor supply and long or short sleep.

The relation between sleep and being overweight differed between women and men. The prevalence of short sleep for overweight and obese women was lower than for women with normal weight. For men, the prevalence of short sleep was higher among those who were overweight and obese than for those with normal weight. For women, being obese also meant a positive correlation with long sleep, while no such relation was found for overweight women. For men, there was no correlation between long sleep and being overweight/obese. This means that women tended to sleep more if they were overweight or obese, while their male counterparts tended to sleep less. This is independent of which way the relationship goes: being overweight might lead to more or less sleep, or more or less sleep might lead to being overweight.

5. Discussion

Today, people in Denmark sleep around the same number of hours as in the mid-1960s, with nearly the same prevalence of short and long sleepers. However, from the mid-1960s to the mid-1970s there was an increase in sleep duration. Thereafter there was a decline, and in the 2000s there was another increase. This is in line with the tendency in Norway during 1971–2000, with a decline in average sleep duration, and a decreasing prevalence of long sleepers; however, in Norway, the prevalence of short sleepers nearly doubled during that period [14]. Nevertheless, when looking at contemporary societies in general, no clear picture emerged of a consistent decrease in sleep duration and increase in the prevalence of short sleep [5].

While the trend in men's sleep duration and prevalence of short and long sleep did not change during 1964–2009, women's sleep duration fell significantly, but not their short and long sleep prevalence. However, controlling for the development in employment rates (ie, employed vs unemployed) implied that women's sleep duration decreased less and men's did not change significantly. This shows that structural changes in society were correlated with sleeping behavior.

This does not contradict the notion that periods of recession are positively associated with sleep duration, reflecting more time to sleep in periods of lower employment or indicating longer time-in-bed in an attempt to compensate for a decrease in sleep quality [15]. The latter explanation seems more likely, given that previous studies have found more complaints of sleep disturbances during periods of economic downturn [16,17], and economic downturns are associated with declines in psychological health in general. However, increasing labor market attachments – employment rates – are certainly of more importance for changes in sleep duration, in as much as they reflect long-term societal economic growth.

It was also found that there were no significant seasonal variations in sleep duration and short sleepers between the first and the other quarters of the year; only the prevalence of long sleepers was lower in the first quarter. This finding, which generally confirms the findings in Reference 18, is important here because most of the Danish data that were used were collected during early spring; therefore, this seems to offer reasonable proxies for average sleep durations over a whole year. Nevertheless, future studies should include information for the whole calendar year, as well as more output information regarding health, family, and labor market careers.

A limitation of the use of time-use data was that the two diary days were not necessarily consecutive days, which led to constructing artificial night-sleeping patterns rather than using information relying on a full night's sleep period. However, for some respondents, the 2 days followed each other, and it was found that there

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was no significant difference in the calculated sleeping time for that day/night (see [10,19]).

Moreover, the increase in insomnia questions the constant sleep duration when measured as time in bed. However, only a few studies have investigated the trend in the prevalence of insomnia in the Nordic countries over a longer period, among them a Finnish study, which found a slightly U-shaped trend over the period 1979–2002 [20].

The use of diary data, however, is superior to questionnaire information, because diary data are found to be more reliable in measuring time-use, including sleep (see [21,22]).

The fact that there are not more short sleepers in Denmark today than before should, nevertheless, give rise to public health concern, simply because significant relationships have been found between sleeping too little and being overweight or obese. However, the problem is that the causality is not known: does being overweight reduce sleep duration, or does sleep duration affect the likelihood of being overweight? For that reason, panel data are needed to shed light on that major issue.

Lastly, future time-use studies should include stylized sleep duration questions in addition to diary information and, perhaps more importantly, sleep quality questions to motivate more methodologically advanced analyses of sleep patterns and sleep problems in the population.

6. Conclusion

Today in Denmark, people are sleeping the same number of hours as in the mid-1960s, with the prevalence of short and long sleepers being nearly the same. However, from the mid-1960s to the mid-1970s there was an increase in sleep duration followed by a period of decline; and in the 2000s, sleep duration increased again.

Women's sleep duration fell significantly, but not their short and long sleep prevalence. However, controlling for the development in employment rates implied that women's sleep duration decreased less and men's did not change significantly.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2014.10.021.

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